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ABSTRACT

This document presents materials that were developed for a presentation explaining how the Gordon Cooper Technology Center in Shawnee, Oklahoma, obtained state certification for the geometry and trigonometry program that is embedded in its residential and commercial construction program and enables its students to receive high school geometry or trigonometry credit and thereby meet the Oklahoma PASS (Priority Academic Student Skills) objectives for high school math credit. The document begins with a brief description of the presentation's objectives and content. The remainder of the document consists of the following presentation handouts: (1) excerpts from Oklahoma legislation regarding high school graduation requirements affecting students attending technology centers; (2) the program approval letter sent to the technology center; (3) a description of the math program approval process; (4) information about the high school transcripting options at the technology center; (5) integrated math schedules for the program's math teachers; (6) a PASS geometric objectives and carpentry geometry objectives crosswalk; (7) a syllabus and curriculum description for the carpentry geometry course; (8) the carpentry course sequence and curriculum description; (9) information on carpentry-based state competency tests in Oklahoma; (10) the geometry and carpentry teaching sequence; (11) samples of customized geometry lessons and carpentry learning activity packets; and (12) the presenters' credentials. (MN)

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ED 475 345

GETTING STATE CERTIFICATION IN YOUR EMBEDDED MATH PROGRAMS

Gordon Cooper Technology Center

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GETTING STATE CERTIFICATION IN YOUR EMBEDDED MATH PROGRAMS

Description:

This presentation describes the process of developing state certified geometry and trigonometry program in technology centers to meet the Oklahoma PASS Objectives for high school math credit. In this groundbreaking program, students receive high school geometry or trigonometry credit while attending the technology center, thus complying with increasing math requirements for graduation.

Objectives:

1. Review increasing math requirements for high school students
2. Cover PASS objectives for geometry and the geometry carpentry objectives and curriculum
3. Lay out carpentry program objectives
4. Schedule and integrate successful implementation of program

Session outline:

Math requirements – Jodie Eiland

- Increased pressure from public for better performance
- Required implementation of 4 x 3 and other programs
- Students ask "why do we need to learn this stuff"

PASS objectives – Janet Capps

- Define local requirements
- Match PASS objectives to program schedule
- Develop sequence for teaching

Carpentry program objectives – Jodie Eiland

- Develop logical teaching sequence
- Review state competency objectives

Scheduling and integration – Janet Capps

- Lay out weekly focus of program instruction
- Customize geometry curriculum to program relevant problems
- Tips for ease of implementation

Handouts:

- Oklahoma House Bill 2886
- Oklahoma State Department of Education accreditation approval letter
- Embedded math program approval process
- High school transcripting options at Gordon Cooper Technology Center
- Integrated math schedules for both math teachers
- PASS geometry objectives and carpentry geometry objectives cross walk
- Syllabus and curriculum description for carpentry geometry course
- Carpentry course sequence and curriculum description
- Carpentry-based state competency tests in Oklahoma
- Geometry & carpentry teaching sequence
- Samples of customized geometry lessons and carpentry LAPS
- Presenters' credentials

OKLAHOMA HOUSE BILL 2886
Signed by Governor Keating April 29, 2002

The Oklahoma Senate and House of Representatives passed HB 2886 in April 2002. The bill amended 70 O.S. 2001, Section 11-102.6, which related to high school graduation requirements. The bill added certain courses, which count for the core curriculum requirements, modified credit granting requirements, and encouraged school districts to adopt class schedules that allowed enrollment at a technology center school district to count as core academic credits.

The following except from the law mentioned above describes the changes made affecting high school math requirements:

B. Beginning with the 2002-2003 school year, in order to graduate from a public high school accredited by the State Board of Education with a standard diploma, students shall complete the following core curriculum units or sets of competencies at the secondary level:

2. Mathematics 3 units or sets of competencies, to consist of 1 unit or set of competencies of Algebra I or Algebra I taught in a contextual methodology, and 2 units or sets of competencies which may include, but are not limited to, the following courses:

a. Algebra II,

b. Geometry or Geometry taught in a contextual methodology,

c. Trigonometry,

d. Math Analysis or Precalculus,

e. Calculus,

f. Statistics and/or Probability,

g. Computer Science,

h. Contextual mathematics courses which enhance technology preparation whether taught at a:

(1) comprehensive high school, or

(2) technology center school when taken in the eleventh or twelfth grade, taught be a certified teacher, and approved by the State Board of Education and the independent district board of education,

i. mathematics courses taught at a technology center school by a teacher certified in the secondary subject area when taken in the eleventh or twelfth grade upon approval of the State Board of Education and the independent district board of education, or

j. other mathematics courses with content and/or rigor equal to or above Algebra I.

SANDY GARRETT
STATE SUPERINTENDENT OF PUBLIC INSTRUCTION
STATE OF OKLAHOMA

May 3, 2001

Dear Administrator:

At the April 19, 2001 board meeting, the State Board of Education approved the specific courses which had embedded Geometry competencies and embedded Trigonometry competencies as taught at **Gordon Cooper Technology Center only.** Gordon Cooper Technology Center presented their curriculum and went through an extensive review process by the State Department of Education and outside mathematics curriculum experts. The review included verifying alignment of the curriculum with the Priority Academic Student Skills and an on-site review of the curriculum at Gordon Cooper Technology Center before being submitted to the State Board of Education.

Any technology center that would like approval of embedded competencies for Career Technology courses would need to submit their curriculum for review; provide documentation of how the competencies were embedded in the curriculum; and formally request approval by the State Board of Education.

Please contact Cindy Koss, Team Leader, Curriculum/Effective Schools, at (405) 521-4513, if you have questions.

Sincerely,

Sandy Garrett

Sandy Garrett
State Superintendent

SK:ck

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GORDON COOPER TECHNOLOGY CENTER
EMBEDDED MATH PROGRAM
APPROVAL PROCESS

Gordon Cooper Technology Center is making changes to meet the challenges and opportunities in the workplace of the 21st century.

Over the past five years, the Gordon Cooper Technology Center administration and school board have worked together to better integrate career and technology training with rigorous academics. As part of that effort, a recent school initiative resulted in the Oklahoma State Board of Education granting accreditation for students in nine different programs to receive geometry or trigonometry credit in addition to career technology credits.

The road to geometry and trigonometry accreditation began with the hiring of two fulltime roving mathematics instructors. Janet Capps came to the technology center in July of 1999 with 26 years of previous experience teaching secondary math in Oklahoma. Jeff Howard was also hired in 1999.

Ms. Capps was assigned to work with instructors to develop a math curriculum used to teach the math required in each career-technology program. She cross-referenced the National Council of Teachers of Mathematics Standards and Oklahoma Priority Academic Students Skills objectives with the duty-task lists of the vocations and found that nine of the school's programs met either geometry or trigonometry criteria in the math required in each program. Ms. Capps and Mr. Howard go into every career and technology classroom at Gordon Cooper Technology Center to teach math contextual to the specific program. They work hand-in-hand with the instructors in each program to teach the objectives, as the students need them to complete projects in their classes.

Gordon Cooper Technology Center Superintendent Beth Little worked closely with school counselor and former secondary math instructor Carrie Boettger and the school's math instructors to present the concept to the state Department of Education and state Superintendent Sandy Garrett. State education officials were initially skeptical about the amount of mathematical rigor contained in the school's roving math initiative. With diligent preparation and planning, the Gordon Cooper educators were able to demonstrate the importance, relevance and rigor of the math initiative. The Gordon Cooper team met with Department of Education officials several times to present the concept and answer questions. A state Department of Education official conducted an on-site review and observation of the math instruction process. The extensive review included verifying alignment of the curriculum with the PASS objectives plus on-site review of the curriculum and delivery methods.

In April 2001 the geometry and trigonometry credit proposal was placed on the agenda of the state Board of Education. After considerable discussion involving the Gordon Cooper team, the board voted unanimously to approve the specific courses, which had integrated geometry competencies and integrated trigonometry competencies as taught at Gordon Cooper Technology Center only.

Partner school administrators and teachers embraced the news as a welcome path for high school students to learn career skills while simultaneously earning higher mathematics credit required for high school graduation and college entrance. Geometry credit was approved for welding, auto service, computer-aided drafting, Computerized Manufacturing Technology I, electricity, heating and air conditioning, and carpentry. Trigonometry credit was approved for Computerized Manufacturing Technology II and telecommunications/electronics.

GORDON COOPER TECHNOLOGY CENTER
COURSE UNITS
HIGH SCHOOL TRANSCRIPTING OPTIONS

COURSE	YEAR	TECHNOLOGY UNITS	OPTIONAL ACADEMIC UNITS
Applied Welding Technology	Year 1 Year 2	3 units 4 units	1 unit Geometry[1]
Automotive Service Technology	Year 1 Year 2	3 units 3 or 4 units	1 unit Geometry[1] and/or 1 unit Contextual Intermediate Algebra[4]
Aviation Maintenance Technology	Year 1 Year 2	4 units 4 units	
BUSINESS & COMPUTER Accounting and Financial Services E-Commerce Web Programming Network Systems Technology Office Management Technology	Year 1 Year 2	3 units 3 or 4 units	1 unit Computer Science I[2] 1 unit Computer Science II[2]
Business Marketing/Management	Year 1 Year 2	4 units 4 units	
Child Care Development	Year 1 Year 2	4 units 4 units	
Collision Repair Technology	Year 1 Year 2	3 units 4 units	1 unit Contextual Intermediate Algebra[4]
Computer Aided Drafting	Year 1 Year 2	3 units 3 or 4 units	1 unit Geometry[1] and/or 1 unit Computer Science I or II[2]
Computerized Manufacturing Technology I and II	Year 1 Year 2	3 units 3 units	1 unit Geometry (CMT I)[1] 1 unit Trigonometry (CMT II)[1]
Electrical Careers Technology	Year 1 Year 2	3 units 4 units	1 unit Geometry[1]
Computer Graphic Design	Year 1 Year 2	3 units 3 or 4 units	1 unit Computer Science I[2] 1 unit Computer Science II[2]
Health Careers Certification (one year only)	Year 1	3 units	1 unit Anatomy/Physiology[3]
Heating, Air Conditioning & Refrigeration Technology	Year 1 Year 2	3 units 4 units	1 unit Geometry[1]
Telecommunications/Electronics Technology	Year 1 Year 2	3 units 3 or 4 units	1 unit Trigonometry[1] and/or 1 unit Computer Science I or II[2]
Masonry Trades	Year 1 Year 2	3 units 4 units	1 unit Contextual Geometry[4]
Occupational Services A & B	Year 1 Year 2	4 units 4 units	
Professional Diesel Technology	Year 1 Year 2	3 units 4 units	1 unit Contextual Intermediate Algebra[4]
Residential/Commercial Construction	Year 1 Year 2	3 units 4 units	1 unit Geometry[1]

Effective August 2002

UNITS OF CREDIT: Accreditation Standards indicate 1 unit of credit may be awarded for 120 hours of instruction. These courses include 525 hours of instruction each year for a high school student. This is equivalent to 4+ units.

1. Geometry and Trigonometry courses are taught by certified secondary math instructors and aligned to PASS Objectives. A competency test is also required. APPROVED BY THE STATE BOARD OF EDUCATION 4/19/01.

2. These courses are taught by certified instructors and meet the SDE requirements for Computer Science credit. Computer Science I and II may be used to satisfy mathematics requirements for a Standard Diploma.

3. Anatomy/Physiology satisfies a science requirement for high school graduation. APPROVED BY THE STATE BOARD OF EDUCATION 7/25/02.

4. These courses are taught by certified math teachers with content and/or rigor equal to or above Algebra I, therefore, satisfying a math requirement for a standard diploma. (Covers PASS Objectives from Algebra & Geometry)

APPLIED MATH SCHEDULE
Janet Capps
2002-2003

MONDAY **DATE:** **Every week**	**Automotive & Diesel Tech** **8:25-9:50 A.M.** **12:55-2:20 P.M.** **Telecommunications/ Electronics** **10:00-11:25 A.M.** **2:30-3:55 P.M.**	**Contextual Automotive Math course taught** **Trigonometry course taught**
TUESDAY **DATE:** **Every week**	**Carpentry** **8:25-9:55 A.M.** **12:55-2:25 P.M.** **Electricity** **10:00-11:25 A.M.** **2:30-3:55 P.M.**	**Geometry course taught** **Geometry course taught**
WEDNESDAY **DATE:** **Every week**	**Machining I** **8:25-9:55 A.M.** **12:55-2:25 P.M.** **Machining II** **10:00-11:25 A.M.** **2:30-3:55 P.M.**	**Geometry course taught** **Trigonometry course taught**
THURSDAY **DATE:** **Every week**	**Computer-Aided Drafting** **8:25-9:55 A.M.** **12:55-2:25 P.M.** **Collision Repair Tech** **10:00-11:25 A.M.** **2:30-3:55 P.M.**	**Geometry course taught** **Contextual Math course taught**
FRIDAY **DATE:** **Every week**	**Math sessions over specific topics** **Makeup any classes missed during week** **Child Care Development monthly** **8:30-9:30 A.M.** **1:00-2:00 P.M.** **(Any class can schedule this time, if needed.)**	**ACT Math Prep sessions** **State VICA Math Test Prep** **Adult Professional Diesel, as needed** **Make-Up work for students absent or extra help** **9:50-11:25 A.M.** **2:20-3:25 P.M.** **(Any class can schedule this time, if needed.)**

TUTORING: Unless a meeting is scheduled, I am available for tutoring from 12:15 to 12:45 p.m. every day in the EEC. Any student from any class may come in for extra academic help.

TEACHERS: The schedule above shows my set class schedule. Any time I am not scheduled and I can help your students with math call me at extension 293 and schedule a day and time or stop by I-10 and make arrangements with me.

Jeff Howard's EEC Math Schedule
2002/2003

	Monday	Tuesday	Wednesday	Thursday	Friday
Morning	**8:25 – 9:55** Auto – A Geometry Credit Class **10:15 – 11:20** LPN Aug12 – Aug 29 AM Marketing AM (after Aug 29) <Alternating weeks with> OCS	**8:25 – 9:55** Masonry Contextual Geometry Credit Class **10:15 – 11:20** Health (AR 1st semester, AB 2nd semester)	**8:25 – 9:55** HAR Geometry Credit Class **10:15 – 11:20** CGD Aug 21 – Oct 16 Networking / E-Com Oct 23 – 2nd Semester	**8:25 – 9:55** Welding Geometry Credit Class **10:15 – 11:20** BIT-D (1st Semester) BIT-C (2nd Semester)	Class Make-Up Extra help Study Session Absent Make-UP Accuplacer Testing and Prep
Afternoon	**12:55 – 2:25** Auto – A Geometry Credit Class **2:45 – 3:55** BIT-T PM (1st Semester) BIT-E PM (2nd Semester) <Alternating weeks with> OCS	**12:55 – 2:25** Masonry Contextual Geometry Credit Class **2:45 – 3:55** Health (AR 1st semester, AB 2nd semester)	**12:55 – 2:25** HAR Geometry Credit Class **2:45 – 3:55** CGD Aug 21– Oct 16 Networking / E-Com Oct 23 – 2nd Semester	**12:55 – 2:25** Welding Geometry Credit Class **2:45 – 3:55** BIT-D (1st Semester) BIT-C (2nd Semester)	Class Make-Up Extra help Study Session Absent Make-UP Accuplacer Testing and Prep

If your class comes in conflict with a school activity it will be rescheduled on the following Friday.
Students who are having difficulty with assignments may come in for extra help on Friday.
Students who are absent may come to make up their missed work on Friday.

GORDON COOPER TECHNOLOGY CENTER

Shawnee, Oklahoma

GEOMETRY

OBJECTIVES

for

TECHNICAL MATH/GEOMETRY

RESIDENTIAL AND COMMERCIAL CONSTRUCTION

RESIDENTIAL AND COMMERCIAL CARPENTRY (RCC)
GEOMETRY OBJECTIVES

I. Compute the missing lengths on geometric objects and express the length using the appropriate unit of measure. (PASS II.C.)

II. Use the properties of 2- and 3-dimensional figures to find the perimeter/circumference and area of triangles, quadrilaterals, polygons, and circles with missing information and correctly identify the appropriate unit of measure. (PASS II.B.)

III. Calculate the volume and surface area of rectangular solids, cylinders, pyramids, and cones and convert volumes and areas from one square or cubic unit of measure to another. (PASS II.C.)

IV. Use deductive reasoning skills to take given dimensions and specifications and design a building. (PASS I.C.1.)

V. Draw a blueprint for an object or building using architect scales and engineering scales. (PASS II.D. and II.A.)

VI. Use automated technology (scientific calculator and computer) to compute, sort data, and retrieve information needed. (PASS V.B.)

VII. Read, setup, and use graphs, charts, and tables to formulate hypotheses, make predictions, test conjectures for a variety of applied purposes. (PASS V.B.)

VIII. Use inductive reasoning skills and graphing to make and test conjectures about the sum of the angles of any triangle and about the Pythagorean Theorem. (PASS I.C.1.)

IX. Use inductive reasoning skills to construct a simple valid argument to explain the value of pi and the relationship between the diameter and circumference of a circle. (Circle lab) (PASS I.C.5.)

X. Use geometric(rulers, compasses, protractors) and carpentry tools(tape measures, T-squares, levels, etc.) to measure accurately and draw scale drawings of 2- and 3-dimensional geometric objects. (PASS II.A. and D.)

XI. Use properties of 2D and 3D shapes to determine unknown values and apply their properties to construction problems. (PASS II.B.)

XII. Deduce properties and relationships of lines (parallel and perpendicular) and angles (complementary, supplementary, vertical, etc.) and apply these properties to construction problems. (PASS I.A.2.)

XIII. Solve problems using the properties of different types of angle relationships, such as vertical, corresponding, alternate interior, alternate exterior, etc. (PASS IV.A.)

XIV. Use the Pythagorean Theorem and its converse to find missing side lengths on triangles, rafters, stairs and steps, roof trusses, and other construction problems. (PASS IV.B.)

XV. Deduce special relationships of parallel lines with a transversal using graph paper and a protractor and formulate counterexamples to show that only parallel lines have these special relationships with a transversal. (PASS I.A.1. and I.C.2.)

XVI. Use inductive reasoning skills to follow arguments that determine the relationships of congruency and similarity—how are they alike and how are they different? (PASS I.B. and I.C.3.)

XVII. Use the relationships of congruency and similarity to determine unknown values in triangles and other polygons. (PASS I.B.)

XVIII. Use graph paper, steel rule, and protractor to judge the validity of the 30-60-90 triangle and the 45-45-90 triangle special relationships. (PASS I.C.4.)

XIX. Use the 30-60-90 and 45-45-90 triangles relationships to solve special right triangles for unknown values. (PASS IV.A.)

XX. Find angle measures formed inside and outside circles and the related arc measures on the circles. (PASS II.E.)

XXI. Use coordinate geometry to find distance between two points in construction problems. (PASS III.B.1.)

XXII. Determine the slopes of horizontal, vertical, parallel, and perpendicular lines in construction applications using coordinate geometry. (PASS III.B.3.)

XXIII. Use coordinate geometry to find the midpoint of a segment and apply to support beams, locating studs, gable roofs, etc. (PASS III.B.2.)

XXIV. Determine the type of geometric figure given a set of points to graph or a set of descriptive properties for all types of triangles, quadrilaterals, regular hexagons, and regular octagons. (PASS III.C.)

XXV. Express the trigonometric functions as ratios and derive the relationship between sine, cosine, and tangent ratios, and use to solve real-world problems. (Use a calculator or printed tables.) (PASS IV.C.)

XXVI. Use transformations (reflections, rotation, translation) with coordinate geometry. (PASS III.A.)

XXVII. Use the Fundamental Counting Principle to solve problems. (PASS V.D.)

XXVIII. Determine the probability of geometric relationships involving "and", "or", or "not". (PASS V.C.)

XXIX. Collect construction data and display on a scatter plot and identify which equation/model is the curve of best fit for the data collected. (PASS V.A.)

PRIORITY ACADEMIC STUDENT SKILLS
GEOMETRY

I. Logical Reasoning

A. Deduce properties and relationships of figures from given assumptions and information to show:

1. Relationships of parallel lines with a transversal. (RCC Objective XV.)

2. Relationships between pairs of angles (e.g., adjacent, **complementary**, vertical). (RCC Objective XII.)

B. Determine and use the relationships of **congruency** and similarity to determine unknown values. (RCC Objective XVI.)

C. Use logical reasoning skills (inductive and deductive) to: (RCC Objective XVII.)

1. Make and test **conjectures** (RCC Objective VIII.)

2. Formulate counter examples (RCC Objective XV.)

3. Follow logical arguments (RCC Objective XVI.)

4. Judge the validity of arguments (RCC Objective XVIII.)

5. Construct simple valid arguments (RCC Objective IX.)

II. Properties of 2- and 3- Dimensional Figures

A. Draw and analyze 2- and 3-dimensional figures. (RCC Objectives V. and X.)

B. Use properties of 2- and 3-dimensional figures to determine unknown values (e.g., given the perimeter/ circumference, find the area). (RCC Objectives II. and XI.)

C. Compute length, perimeter/circumference, area, volume, and surface area of geometric objects with missing information and correctly identify the appropriate unit of measure of each. (RCC Objectives I. and III.)

D. Use geometric tools (e.g. protractor, compass, straight edge) to construct a variety of figures. (RCC Objectives V. and X.)

E. Find angle measures and arc measures related to circles. (RCC Objective XX.)

III. Coordinate Geometry

A. Use **transformations** (reflection, rotation, translation) with coordinate geometry (e.g., reflect points across the y-axis). (RCC Objective XXVI.)

B. Use coordinate geometry to find:

1. Distance between two points (RCC Objective IV.)
2. Midpoint of a segment (RCC Objective XXIII.)
3. **Slopes** of parallel, perpendicular, horizontal, and vertical lines (RCC Objective XXII.)

C. Given a set of points determine the type of figure based on its properties (e.g., parallelogram, isosceles triangle, regular octagon). (RCC Objective XXIV.)

IV. Angles and Triangles

A. Solve problems using properties of angles (e.g., interior, exterior, **complementary**, vertical, angles sums, 30-60-90). (RCC Objectives XIII. and XIX.)

B. Use the Pythagorean Theorem and its converse to find missing side lengths and to determine acute, right, and obtuse triangles. (RCC Objective XIV.)

C. Express the trigonometric functions as **ratios** and derive the relationship between **sine, cosine,** and **tangent ratios**, and use to solve real world problems. (RCC Objective XXV.)

V. Data Analysis, Statistics, and Probability

A. Collect data involving two variables and display on a **scatter plot**; interpret results using a linear or quadratic model/equation and identify whether the model/equation is a curve of best fit for the data (e.g., given a **scatter plot** and several linear or quadratic equations, which one is the best fit?). (RCC Objective XXIX.)

B. Use data and statistical measures for a variety of purposes (e.g., formulate hypotheses, make predictions, test **conjectures**). (RCC Objectives VI. and VII.)

C. Determine the **probability** of an event involving "and", "or", or "not". (RCC Objective XXVIII.)

D. Use the Fundamental Counting Principle to solve problems (e.g., find the possible ways to label the vertices of a polygon). (RCC Objective XXVII.)

GORDON COOPER TECHNOLOGY CENTER

Shawnee, Oklahoma

SYLLABUS

and

CURRICULUM DESCRIPTION

for

TECHNICAL MATH/GEOMETRY

RESIDENTIAL AND COMMERCIAL CONSTRUCTION

Gordon Cooper Technology Center
Shawnee, Oklahoma

SYLLABUS

INSTRUCTIONAL PROCEDURES:

Although the instructor teaches the objectives through a variety of methods, much of the presentation will follow a lecture/discussion format with the instructor explaining and demonstrating the desired skills and monitoring student progress. The instructor uses signal responses, questioning techniques, and guided practices to involve all students.

Each student is required to participate in the lecture/discussions and guided practices and will be graded on participation each session the class meets. Written work will be completed in group settings or as individuals.

The instructor communicates the instructional objectives to students, stresses sequence, and relates the topics to existing student experiences and employment needs. All students are required to practice newly learned skills with and without the direct supervision of the instructor.

The variety of learning materials used include visual presentations, mediated instruction, printed materials, and appropriate technology. These and other methods will be used to keep the class interesting and meaningful.

The instructor establishes rapport with students and provides a pleasant, safe, and orderly climate conducive to learning.

INSTRUCTOR/STUDENT RESPONSIBILITIES:

The instructor clearly defines expected behavior regarding assignments, activities, and completion dates as the instructional objectives are communicated to the students.

The student's primary obligation is to demonstrate competencies as defined in the objectives. Students who need additional help should notify the instructor who will provide additional assistance on a one-to-one basis.

EVALUATION OF STUDENT ACHIEVEMENTS:

Grades will be earned as wages are earned on a regular job. Students will receive grades for daily performance, for written assignments, and the competency test at end of each semester.
Each nine weeks grade will be based on total possible points and count as 40% of the semester grade. The competency test at the end of each semester will account for the other 20% of the semester grade.

A = 100 – 90
B = 89 – 80
C = 79 – 70
D = 69 – 60
F = 59 – or lower

20

I = Incomplete
WP = Withdrew Passing
WF = Withdrew Failing

Students will be kept informed of their grades and notified when examinations are scheduled. Any student should inquire of the course instructor if he/she does not understand or agree with points recorded. The instructor will critique tests and student assignments in a classroom setting.

WORK AND ASSIGNMENT MISSED:

Students who are absent and do not receive an excused absence will be assigned a zero for all work missed. Work missed because of an absence must be made up to the satisfaction of the instructor within two weeks of the date of absence. It is the responsibility of the student to obtain missed assignments from the instructor.

Gordon Cooper Technology Center
Shawnee, Oklahoma

CURRICULUM DESCRIPTION

COURSE TITLE: Technical Math/Geometry

INSTRUCTOR: Janet Capps

UNITS OF CREDIT: 1

PREREQUISITES: Algebra I

COURSE DESCRIPTION:

Introduction to geometry applied in residential and commercial construction. Parallel and perpendicular lines, angles, triangles, other polygons, and circles will be studied extensively. Other topics include measurement, scale drawings, perimeter, area, surface area, volume, right triangles and the Pythagorean Theorem, computation and conversion in feet and inches, rafters, roofing, board feet, framing, ratio and proportion, stairs and steps, weights, percentages, formulas, and concrete.

COURSE OBJECTIVES:

Upon completion of this course the student should be able to:

1. Use a calculator and computer to compute, sort data, and retrieve information needed.
2. Use geometric tools (steel rule, compass, and protractor) and architect and engineer scales to measure accurately and draw blueprints.
3. Use geometric tools (steel rule, compass, and protractor) and carpentry tools (tape measure, T-square, levels, etc.) to measure accurately and construct 2- and 3-dimensional geometric objects.
4. Express measurement answers in the proper unit, converting measurements as needed.
5. Find missing angles and sides in triangles and polygons and apply this to roof trusses, squaring a building, rafters, stairs, steps, and other carpentry applications.
6. Find the perimeter and area of triangles, quadrilaterals, and circles and apply these skills to all types of carpentry problems—tiling, carpeting, trim, gables, roofs, siding, doors and windows, etc.
7. Calculate surface area and volume of rectangular solids, cubes, and cylinders in order to find amount of lumber or concrete needed for foundations, sidewalks, table tops, pillars, footings, walls, etc.
8. Change dimensions to feet and inches or all to inches for accuracy in measurement.

9. Find the length of common rafters and hip rafters using rafter tables, slope, pitch, and the Pythagorean Theorem.

10. Determine how many squares or bundles of roofing are needed using geometric principles.

11. Use ratio and proportion to determine roof pitches, scale drawings, and concrete and mortar mixes.

12. Calculate the number and size of risers and treads and stringer length for a stair of given dimensions.

13. Solve problems involving weight measure to determine safe capacities for soil bearing and hauling materials and determine size of beams.

14. Use sine, cosine, and tangent functions to find missing angles and sides of right triangles and apply to surveying, roof angles, stairs, etc.

15. Use the Pythagorean Theorem to lay out perimeter of a building.

16. Use the properties and relationships of parallel and perpendicular lines, angles, circles, triangles, and other polygons to complete construction problems.

17. Find unknown values in congruent and similar triangles and other polygons using the corresponding angles and sides relationships.

18. Find distance, midpoint, slope of segments and sides of geometric figures.

19. Reflect, rotate, and translate geometric figures

20. Find angles formed inside and outside a circle, arc measures, arc lengths, and the area of a sector.

21. Collect and graph data on scatter plot, analyze, and find curve of best fit for data displayed.

22. Find the probability of geometric relationships.

23. Discover patterns in geometric figures and predict outcomes and general equations for the number of possibilities.

COURSE CONTENT, UNIT ARRANGEMENT:

A. Automated technology
   1. Scientific calculator usage--extended instruction
   2. Computer--drawings

B. Measurement
   1. Using a tape measure
   2. Using a steel rule, compass, and protractor
   3. Conversion
   4. Blueprints (use architect and engineering scales)
   5. Perimeter and circumference

C. Basic geometric figures
   1. Kinds of angles-vertical, complementary, supplementary, etc.
   2. Lines-parallel and perpendicular
   3. Kinds of triangles--angles and sides
   4. Sides and angles of quadrilaterals
   5. Circumference and area of polygons and circles
   6. Angles inside and outside a circle and arcs and sectors
   7. Pythagorean Theorem
   8. Special 30-60-90 and 45-45-90 triangle relationships
   9. Construct 2D and 3D geometric figures
   10. Carpentry applications—roof trusses, gables, door sizes, window sizes, squaring a building, figuring materials needed to build, tile, carpet, trim, roof, etc.

D. Surface area and volume
   1. Formulas for rectangular solids, cubes, cylinders, cones, and pyramids
   2. Concrete needed for sidewalks, walls, footings, pillars, steps, and foundations.
   3. Lumber needed for tabletops and columns and beams and framing.
   4. Weight measurements

E. Rafters
   1. Dimensions expressed in feet and inches
   2. Common rafter length using rafter tables, slope, pitch, and Pythagorean Theorem
   3. Hip rafters
   4. Board foot
   5. Roofing-bundles and squares

F. Ratio and proportion
   1. Roof pitches
   2. Scale drawings
   3. Concrete and mortar mixes

G. Stairs
   1. Stringer length
   2. Risers
   3. Tread

H. Graphing
   1. Cartesian coordinates
   2. Distance, slope, midpoint
   3. Transformations-reflections, translations, rotations
   4. Graphing data in scatter plots

I. Trigonometric functions
   1. Definitions of sine, cosine, and tangent
   2. Surveying
   3. Roof angles
   4. Stair angles

J. Probability

REQUIRED TEXTS, MATERIALS, SUPPLIES:

Usiskin, Coxford, and Hirschhorn, UCSMP Geometry, Prentice-Hall, Inc., 1998, ISBN: 0-673-459-594-7

Huth, Harry C., Practical Problems in Mathematics for Carpenters, Sixth Edition. Delmar Publishers, 1996, ISBN: 0-8273-6987-5

Scientific Calculator

INSTRUCTIONAL MATERIALS:

Various vocational math reference books, overhead transparencies, note sheets, and tools needed for hands-on projects related to topic being taught.

CARPENTRY

Course #	Block One Students	Hours	
		Theory	**Lab**
100	Introduction to Carpentry	10	0
110	Safety	50	30
120	Fundamentals of Carpentry	30	30
130	Foundations	20	80
140	Floor, Wall and Partition Framing	20	85
150	Roof Framing and Stairs	40	130
	Block Two Students		
210	Cornice	15	45
220	Roofing	15	85
230	Vinyl Siding	30	155
240	Interior Wall Finish	15	65
250	Interior Trim	20	80
290	Worksite Learning Component	Flexible	
	Block Three Students		
310R or 315C	Cabinets or Commercial Form	70	205
320R or 325C	Hardware or Metal Stud Framing	30	120
330	Plastic Laminate	20	80
390	Worksite Learning Component	Flexible	
	Total Hours	**385**	**1190**
	Total Program Hours	**1575**	

Half-day students will attend 8:25 a.m. to 11:25 a.m. or 12:55 p.m. to 3:55 p.m., 105 weeks, 3 hours per day, Monday through Friday.

All day students will attend 8:25 a.m. to 3:55 p.m., 53 weeks, 6 hours per day, Monday through Friday.

RESIDENTIAL AND COMMERCIAL CONSTRUCTION

The Residential and Commercial Construction program is designed for job-ready or direct placement employment in the following occupational areas: carpenter, form carpenter, frame carpenter, and finish carpenter (exterior and interior) as well as an introduction to construction management. Proficiency will be developed in basic layout skills, reading working drawings and basic estimating, forming, framing, cornice and finish in both residential and commercial construction.

Completers of this program are prepared to enter the work force at various levels of apprenticeship training. Occupational competency certificates may be earned for construction trainee, carpentry trainee, and cabinetmaker trainee. Basic hand tools must be purchased by start of second year.

RCC 100 **Introduction to Carpentry**
An introduction to the construction field and the employment opportunities available to completers of the program as well as an overview of physical requirements and jobsite conditions.

RCC 110 **Safety**
Basic Job Survival Skills in the Construction Industry. General jobsite safety as well as observation and knowledge of the safe operation of both hand tools and power tools used on the jobsite and in a carpentry shop.

RCC 120 **Fundamentals of Carpentry**
Skills necessary to function on a jobsite. Basic measuring units such as reading tape measures and scales, lineal footage, board footage, square footage, and cubic measurements. Various methods and types and layout products used in all phases of construction. Into to plan reading and basic construction material.

RCC 130 **Residential Forming**
Principles of concrete forming including tools and equipment, safety, materials and estimating. Practical application of the techniques of constructing and setting forms for footings, stem wall, edge forms and slab on grade forms. Including elementary finishing techniques.

RCC 140 **Floor, Wall and Partition Framing**
Basic fundamentals of floor and sill framing on concrete floor or beam systems. Layout of wall framing including windows and door rough openings.

RCC 150 **Roof Framing and Stairs**
Fundamentals of roof framing including gable, gambrel, mansard and hip roofs to include estimating material, layout, and installation as well as basic stair layout and construction.

RCC 210 **Cornice**
Exterior cornice work to include layout and material estimating of wood cornice as well as prep for vinyl soffit. Installing windows and prehung doors are also covered in this module.

RCC 220 **Roofing**
Methods offered include 3 tab and dimensional composition shingles, metal roofing, cold process buildup roofs, as well as into to tile and shake shingle roofing.

RCC 240 **Interior Wall Finish**
Basic interior finish using drywall or paneling as well as tape and bed and texture options available. Insulation material and methods as well as installation are covered as well.

RCC 250 **Interior Trim**
Basic interior finish including doors and millwork common to residential construction.

RCC 290 **Worksite Learning Component**
On the job training to be coordinated by instructor to facilitate learning in a work place environment.

RCC 310R **Cabinets**
For students wishing to focus on residential, the layout, design, and manufacture of cabinets is covered.

RCC 315C **Commercial Form**
Principles of commercial concrete forming including form hardware, safety, materials and estimating. Practical application of the techniques of constructing and setting forms for low, medium, and high walls, columns, beams, above grade slabs and pier and column.

RCC 320R **Hardware**
Intro to residential and cabinet hardware and fixtures.

RCC 325C **Metal Stud Framing**
Commercial framing involving metal stud framing, setting and installing metal door frames, special tools, safety and estimating.

RCC 330 **Plastic Laminate**
Residential and commercial application of plastic laminates is covered.

RCC 390 **Worksite Learning Component**
On the job training to be coordinated by instructor to facilitate learning in a work place environment.

CARPENTRY-BASED STATE COMPETENCY TESTS IN OKLAHOMA

Construction Trainee

Measurement, board feet, triangles, quadrilaterals, circles, perimeter, area, volume and concrete

Form Carpenter

Measurement, triangles, quadrilaterals, circles, perimeter, area, volume and concrete, right triangles, ratio and proportion, stairs, irregular figures, weight measure, percentage, simple trigonometric functions

Finish Carpenter

Measurement, board feet, triangles, quadrilaterals, circles, perimeter, area, right triangles, ratio and proportion, stairs, irregular figures

Frame Carpenter

Measurement, triangles, quadrilaterals, circles, perimeter, area, converting measurements, rafters, right triangles, roofing, ratio and proportion, stairs, irregular figures, percentage simple trigonometric functions

Drywall Installation Trainee

Measurement, triangles, quadrilaterals, circles, perimeter, area, converting measurements, irregular figures, weight measure, percentage

Roofer

Measurement, triangles, quadrilaterals, perimeter, area, converting measurements, right triangles, roofing, ratio and proportion, irregular figures, percentage

Cabinet Maker

Measurement, board feet, triangles, quadrilaterals, circles, perimeter, area, converting measurements, ratio and proportion, irregular figures

GEOMETRY AND CARPENTRY SEQUENCE FOR TEACHING

GEOMETRY	CARPENTRY
FIRST SEMESTER	
Arithmetic and Geometry Pretest – 1 week	Introduction to Carpentry – 1 week
Measurement – 2 weeks	Safety – 6 weeks
Board feet – 1 week	
Triangles – 2 weeks	
Quadrilaterals – 2 weeks	Fundamentals of Carpentry – 4 weeks
Circles – 2 weeks	
Perimeter – 1 week	
Area – 2 weeks	Foundations – 7 weeks
Volume and concrete – 3 weeks	
Review of semester – 1 week	
Competency Test – 1 week	
SECOND SEMESTER	
Converting Measurements – 1 week	Floor, Wall, and Partition Framing – 7 weeks
Rafters – 4 weeks	
Right triangles – 2 weeks	
Roofing – 2 weeks	Roof Framing and Stairs – 11 weeks
Ratio and proportion – 1 week	
Stairs – 1 week	
Irregular figures – 1 week	

Weight measure – 1 week

Percentage – 1 week

Simple trigonometric functions – 1 week

Review of semester – 1 week

Competency Test – 1 week

CARPENTRY
Notes over Triangles

Name _____

The design and construction of many structures such as buildings and bridges are based on a system of triangles. Cross bridging is used between joists to reinforce floors, figure 16-5. A roof truss gives support and rigidity to a roof, figure 16-6. Notice the truss is made up of a combination of triangles.

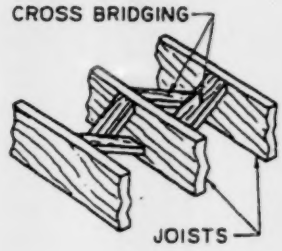

Fig. 16-5

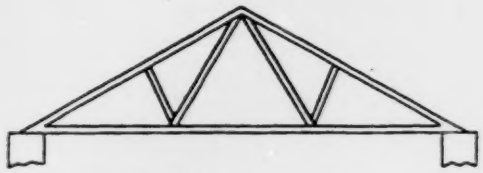

Fig. 16-6 Roof truss

Many objects used in the home are made rigid by means of triangles. The step ladder and shelf brackets show common applications of triangles, figures 16-7 and 16-8.

Fig. 16-7

Fig. 16-8

The designer, drafter, sheet metal technician, welder, and structural steel worker are some of the many craftspeople that require a knowledge of triangles in laying out work. Plumbers and pipefitters compute pipe lengths in diagonal pipe assemblies using triangular relationships. Auto body technicians apply principles of triangles when measuring and repairing automobile frames. Carpenters make use of triangular relationships when checking the squareness of wall corners and computing rafter lengths.

TYPES OF TRIANGLES

An *equilateral triangle* has three equal sides. It also has three equal angles. In the equilateral triangle ABC in figure 16-9, sides $AB = AC = BC$ and $\angle A = \angle B = \angle C$.

An *isosceles triangle* has two equal sides. The equal sides are called *legs*. The third side is called the *base*. The base angles of an isosceles triangle are equal. *Base angles* are the angles that are opposite the legs. In the isosceles triangle DEF shown in figure 16-10, leg DF = leg EF. Since $\angle D$ is opposite leg EF and $\angle E$ is opposite leg DF, $\angle D$ and $\angle E$ are base angles.

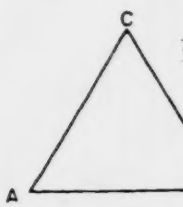

Fig. 16-9 Equilateral triangle

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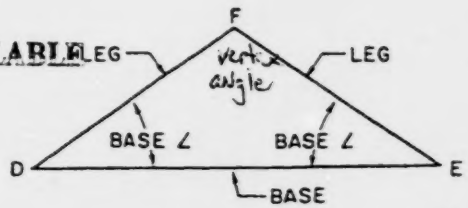


Fig. 16-10 Isosceles triangle

A *scalene triangle* has three unequal sides. It has three unequal angles. Triangle *ABC* in figure 16-11 is scalene. Sides *AB*, *AC*, and *BC* are unequal, and angles *A*, *B*, and *C* are unequal.

A *right triangle* has a right or 90° angle. The symbol for a right angle is ⌞, which is shown at the vertex of the angle. The side opposite the right angle is called the hypotenuse. The other two sides are called legs. Figure 16-12 shows a right triangle with the right angle at *D* and the hypotenuse *EF*.

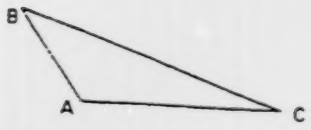


Fig. 16-11 Scalene triangle

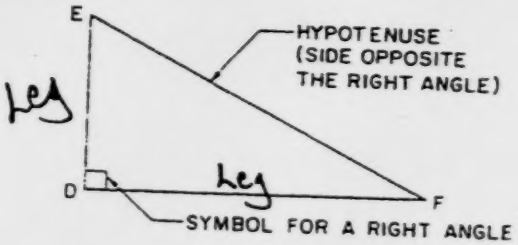


Fig. 16-12 Right triangle

An *acute triangle* has three acute angles. An acute triangle is shown in figure 16-13.

An *obtuse triangle* has one obtuse angle and two acute angles. An obtuse triangle is shown in figure 16-14.

The 3 angles of any triangle add up to 180° (Always)

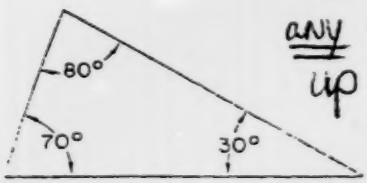


Fig. 16-13 Acute triangle

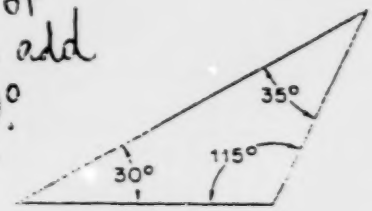
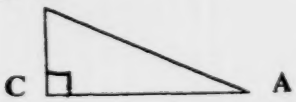
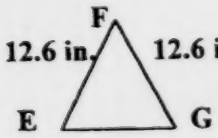


Fig. 16-14 Obtuse triangle

EXAMPLES:

1. 

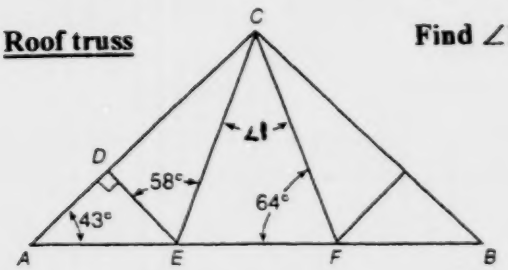
∠A = 22° **Find ∠B. _____**

2. 

a. ∠E = 83° **Find ∠G. _____**

b. ∠G = 55° **Find ∠F. _____**

3. Roof truss



Find ∠1. _____

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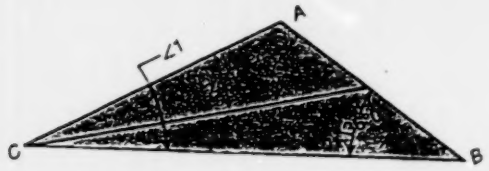
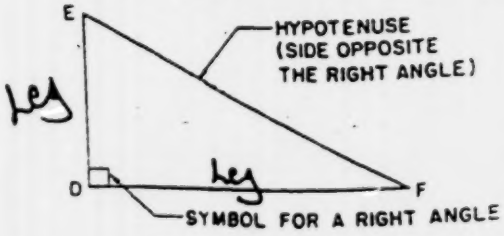
4. $\angle 1 = 25°$ and $\angle 3 = 49°$ Find $\angle 2$ _____



PYTHAGOREAN THEOREM

On any right triangle: $(leg)^2 + (leg)^2 = (hyp.)^2$ **or** $(hyp.)^2 - (leg)^2 = (leg)^2$

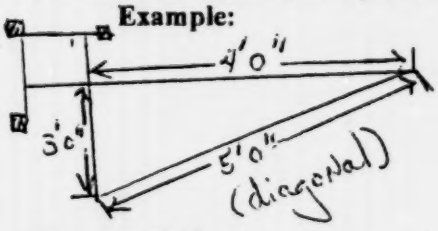


To find hypotenuse: $hyp. = \sqrt{(leg)^2 + (leg)^2}$

To find a leg: $leg = \sqrt{(hyp.)^2 - (leg)^2}$

Use the 3-4-5 Method to square a foundation or a building.

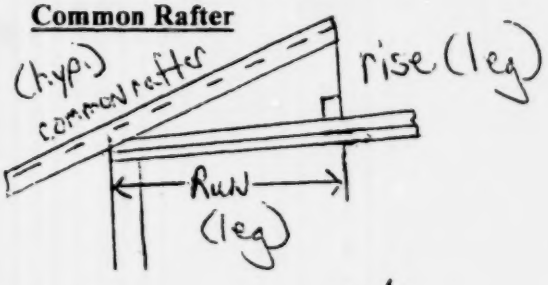
Example:



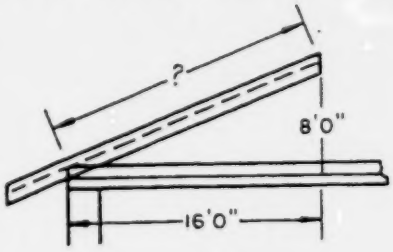
$(3 ft.)^2 + (4 ft.)^2 = (5 ft.)^2$

$9 + 16 = 25$

Common Rafter

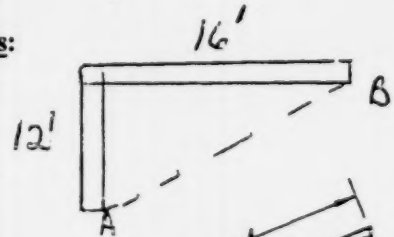


$(run)^2 + (rise)^2 = (common\ rafter)^2$

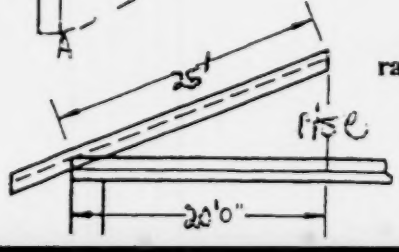


P = _____

Examples:

1. 

AB = _____

2. 

rafter = 25 ft., run = 20 ft. Find rise. _____

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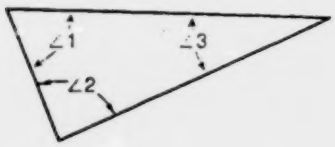
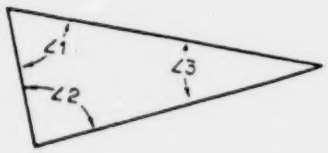
CARPENTRY
Triangles

Name _____

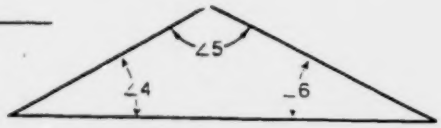
1. If ∠1 = 68° and ∠2 = 85°, find ∠3. _____



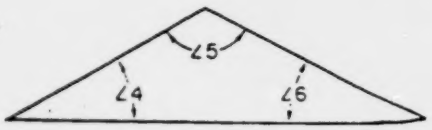
2. If ∠2 = 81° and ∠3 = 33°, find ∠1. _____



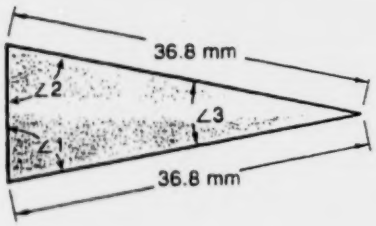
3. If ∠4 = 32° and ∠5 = 122°, find ∠6. _____



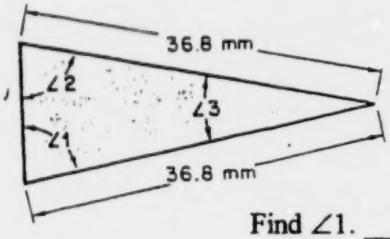
4. If ∠5 = 135° and ∠6 = 27°, find ∠4. _____



5. If ∠3 = 18°, find ∠1. _____



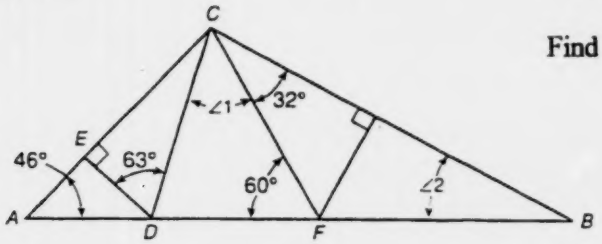
6. If ∠3 = 25°, find ∠2. _____



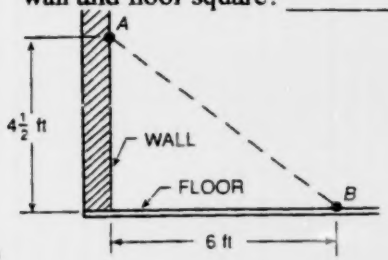
7. Refer to roof truss.

Find ∠1. _____

Find ∠2. _____



8. In remodeling a house, a carpenter checks the squareness of a wall and floor. A 4 ½-foot length is marked off on the wall (point A), and a 6-foot length is marked off on the floor (point B), as shown below. The measurement from point A to point B is 7 ft. 9 in. Are the wall and floor square? _____ You must show your computations.

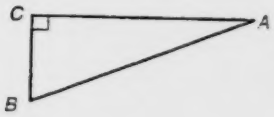


9.

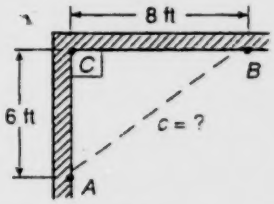
Find ∠1. _____

Find ∠2. _____

10. If ∠ B = 65°, find ∠ A. _____

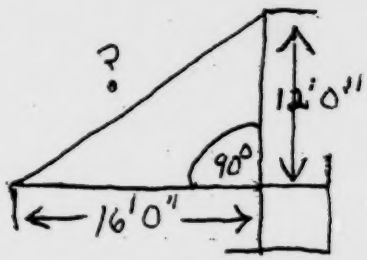


11. To square the corner, find c _____ using the 3-4-5 method.

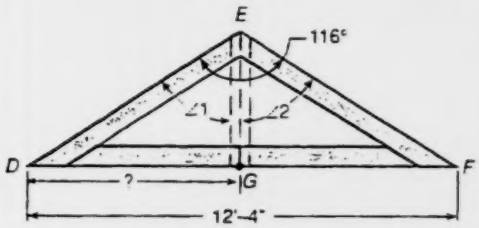


12. Find the length of a common rafter on a roof with rise of 8 feet and a run of 18 feet. _____

13. Use the 3-4-5 method to square the corner and find ? _____

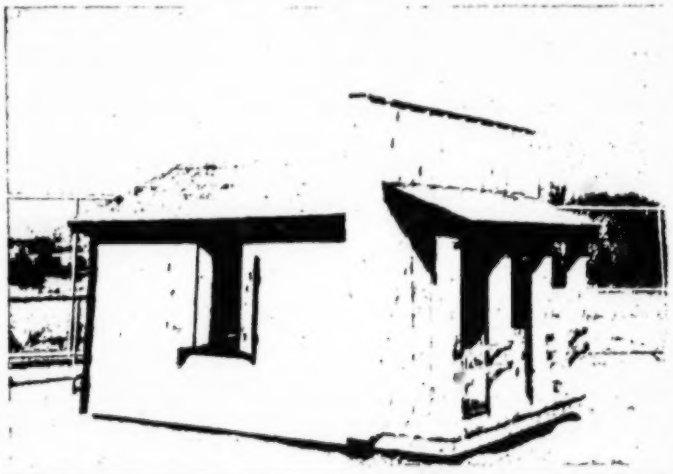


14. Sides DE and EF on the triangular frame DEF are equal. Piece EG is to be fastened to the frame for additional support. Find: ∠1 _____ ∠2 _____ distance DG _____



Gordon Cooper Technology Center

LEARNING ACTIVITY PACKET



LAP No.

Time Range

MAJOR INSTRUCTIONAL AREA

Basic Skills

INSTRUCTIONAL UNIT

3-4-5 Layout

PREREQUISITE(s)

Measuring, Terms

PERFORMANCE OBJECTIVE

Layout a square 90 degree corner using the 3-4-5 method

COMPETENCIES INCLUDED IN THIS LAP

- Measuring

REFERENCE

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Information and Directions

In the following pages, you will find the information you need to perform the operation, job or task you have been assigned. You will find written instructions on the step pages. You will follow them in order and check each step off as you complete it. You will find drawings giving you dimensions and shape of the project. If you cannot find information you need, ask your instructor for assistance.

Tools Needed

20' Measuring Tape
Chalk Line
Pencil
Helper

Materials Needed

None

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Step Directions

heck off each step as completed

_____ 1. Gather all tools and materials.

_____ 2. Chalk a line on the floor approximately 6'-0" long.

_____ 3. Establish a reference joint at one end of the chalk line and label this point A.

_____ 4. Measure from point A down the chalk line 4'-0" and mark a second point. Label this point B.

_____ 5. Measure an approximate right angle to the chalk line from point B a distance of 3'-0" and draw an arc.

_____ 6. Move down the chalk line to the point A and measure from the point A diagonally up towards the 3'-0" arc. This measurement will be 5'-0". Draw a second arc at the 5'0" mark. This method will produce a 90 degree square corner.

_____ 7. If the 3'-0" arc does not intersect with 5'-0" arc, draw the 3'-0" arc sideways until there is an intersection of these two arcs. This intersection will be labeled point C.

_____ 8. Chalk lines from point B to point C and point A to point C.

_____ 9. Have instructor check your work.

_____ 10. Clean up and store tools.

_____ 11. Check progress chart for your next assignment.

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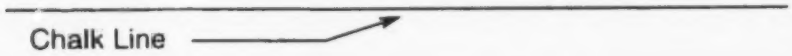
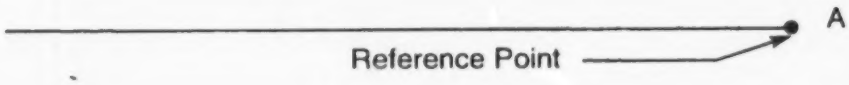
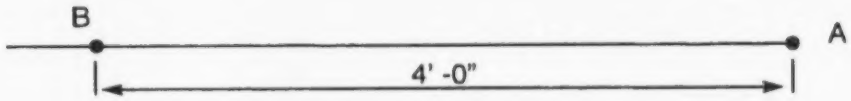
STEP #2



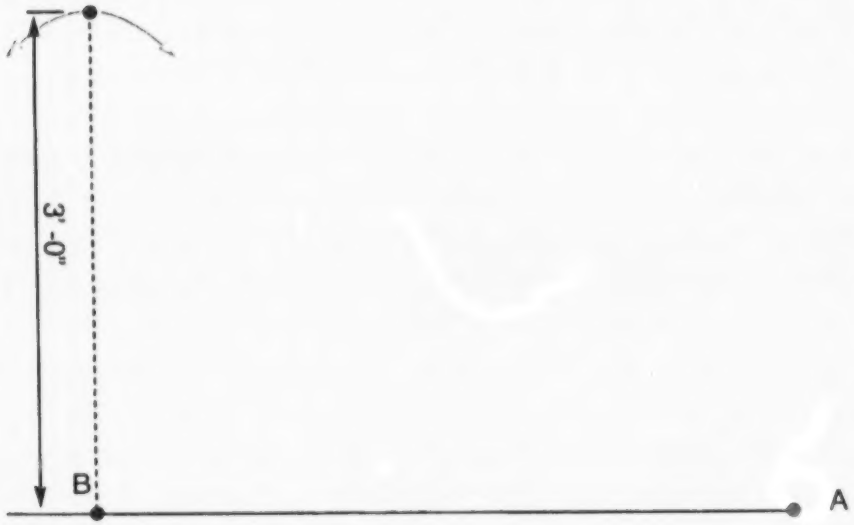
STEP #3



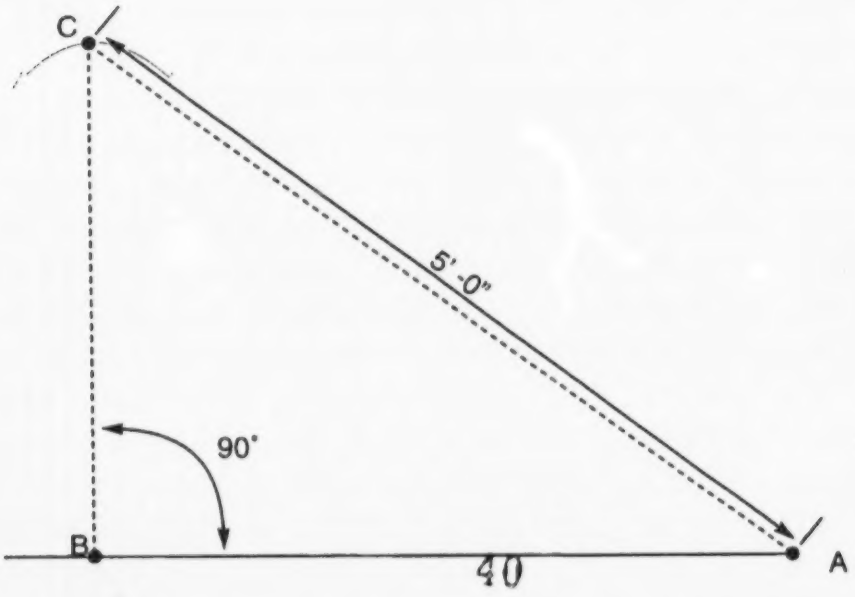
STEP #4



STEP #5



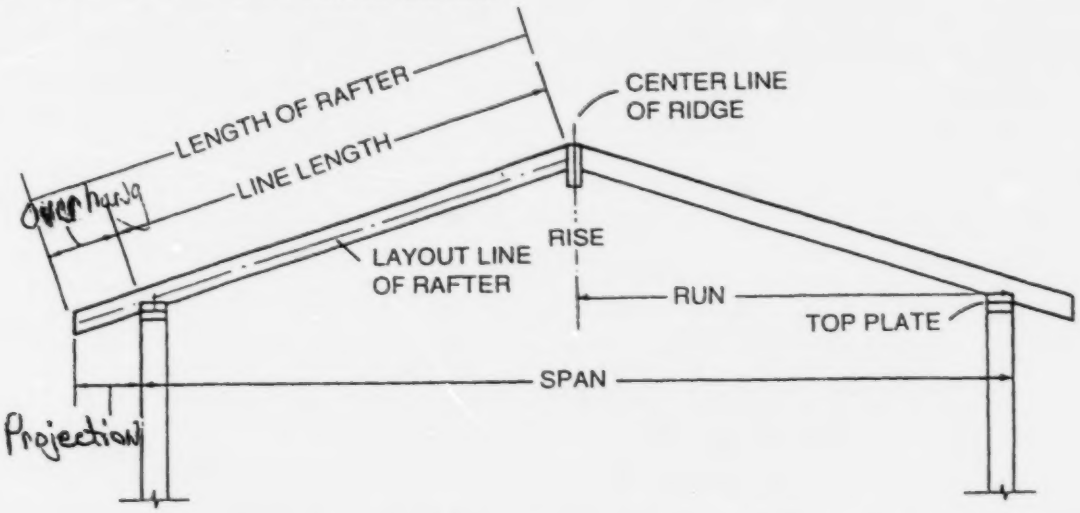
STEP #6



CARPENTRY
Rafter Notes

Rafters or *trusses* are the main structural roof supports. The *ridge* of a roof is the uppermost structural member of a roof. The *top plate* is the horizontal structural member on top of the wall studs. *Common rafters* run form the plate to the ridge. A *hip rafter* is a rafter at the intersection of two slopes of a roof that form an external angle.

Dimensions used in calculating rafter lengths are illustrated. *Line length* is the hypotenuse of a right triangle, the base of which is the run, and the height of which is the rise. The tail is the horizontal distance the rafter projects beyond the wall on which it rests. Overhang is the distance along the center line of the rafter that extends beyond the wall.



Carpenters normally use the rafter table on the steel square to determine the rafter length. In special cases, the carpenter might use the Pythagorean theorem. Rafter stock is sold in lengths from 8 feet to 16 feet in multiples of 2 feet. When estimating the number of rafters for a common gable roof, remember to add one rafter to the total for each side of the roof to allow for the first rafter on each side.

Example: What is the length of the common rafter of a gable roof that has an 8-inch rise per foot of run. The roof span is 24 feet and the overhang is 1 foot.

Solution: Rafter run = 24 feet ÷ 2 = 12 feet

Rafter run and overhang = 12 feet + 1 foot = 13 feet

Using the 8-inch rise on the steel square, the length of the common rafter is 14.42 inches per foot of run.

Length of common rafter = 14.42 inches/foot × 13 feet × 1 foot/12 inches = 15.62 feet

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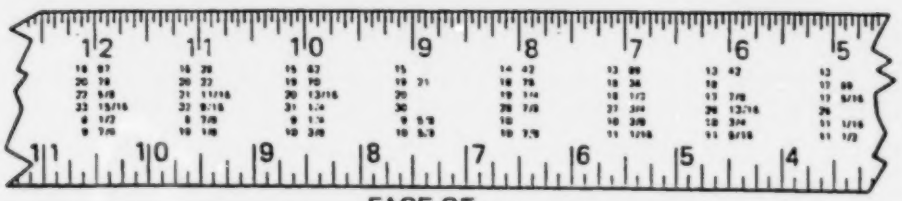
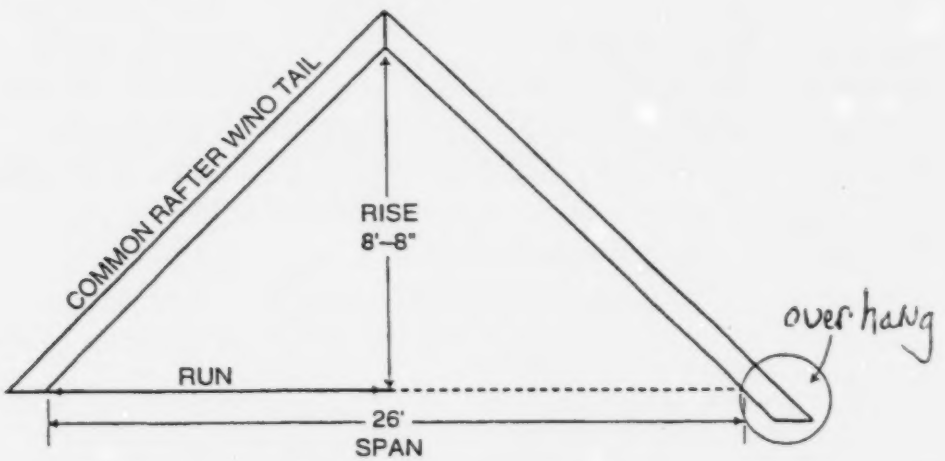


FACE OF
RAFTER TABLE

Study the portion of the framing square shown. Under the 8-inch mark, the first row of numerals reads 14 42. This indicates that for each foot of run with a rise of 8 inches, the length of a common rafter is 14.42 inches.

Example: Find the length of a common rafter (without allowing for tail or overhang) in the building shown.



The span (26 feet) divided by 2 equals the run (13 feet). The rise (8 feet 8 inches or 104 inches) divided by the run (13 feet) equals the *rise per foot of run* (8 inches). Thus, the length of common rafters with a rise of 8 inches per foot of run is 14.42 inches per foot of run. The total length of this rafter is 13 times 14.42 inches or 187.46 inches. To convert this measurement to feet and inches, perform the following operations:

187.46 in ÷ 12 = 15.6216 ft
15.6216 ft = 15 ft + 0.6216 × 12 in
0.6216 × 12 in = 7.459 in
7.459 in = 7 + (0.459 × $^{15}/_{16}$ in) or 7$^{15}/_{16}$ in

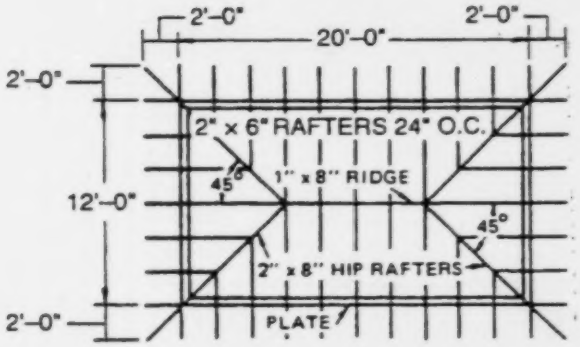
Thus, 187.46 inches equals 15 feet 7$^{15}/_{16}$ inches, the length of the common rafters in the illustration.

EXAMPLES:

1. **Find the length of a common rafter for a span of 24 feet and 1/4 pitch. _____**

2. **Find the number of rafters required for a gable roof that has a 12-inch rise per foot of run, a span of 26 feet, and roof length of 44 feet. The rafters are spaced 16 inches on center. Allow for an overhang of 1 foot. _____**

3.



FRAMING PLAN OF HIP ROOF

What is the length of all the hip rafters needed for the roof shown above if it has a rise of 9 inches for each foot of run? _____

What is the total length of the hip rafters shown if the roof has a rise of 5 inches for each foot of run? _____

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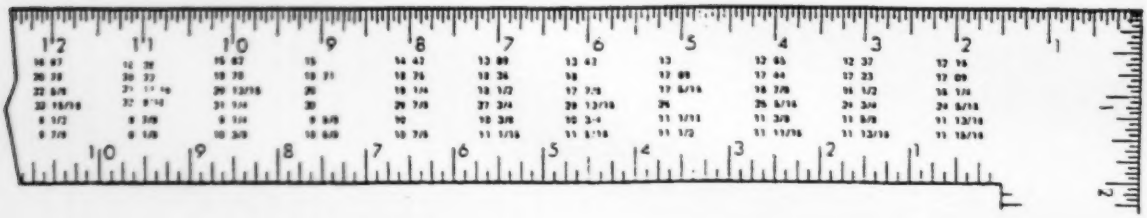
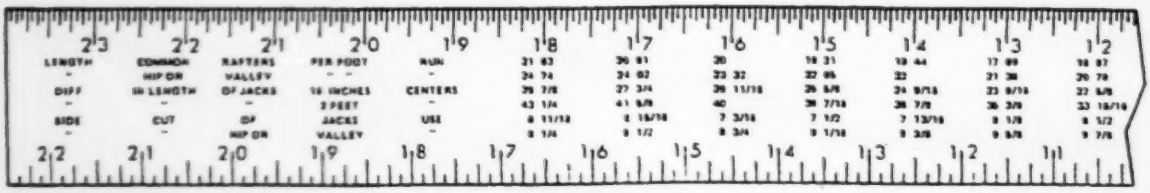
Note: Use the first row of numbers under the inch markings for common rafters.
Use the second row for hip rafters.



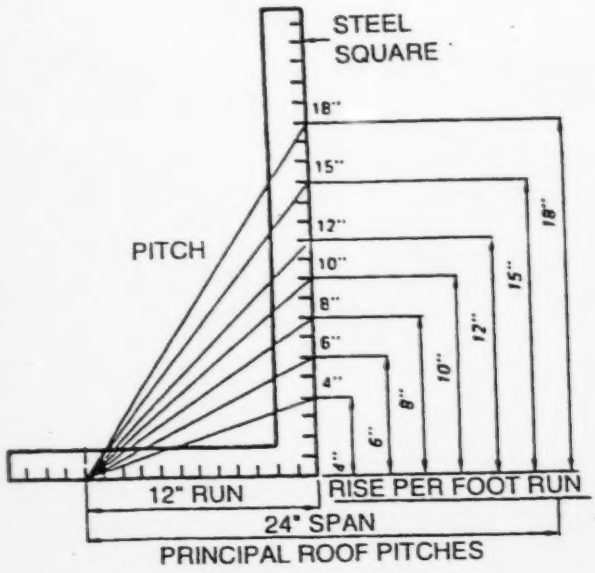


The *pitch* of a roof is the ratio of its rise to its span:

$$\text{pitch} = \frac{\text{rise}}{\text{span}}$$

where rise and span have the same units. Thus, a roof with a ⅙ pitch has a rise of 1 foot per 6 feet of span. This is the same as 12 inches rise per 3 feet (6 ÷ 2) of run, or 4 inches rise per foot of run. To convert quickly from pitch to rise per foot of run, simply multiply pitch by 24:

$$\frac{1}{6} \times 24 = \frac{4 \text{ in rise}}{\text{ft run}}$$



CARPENTRY
Rafters

Name _____

Using the rafter table, find the length of common rafters in the following problems. Express answers correct to the nearest 1/16 inch.

FACE OF
RAFTER TABLE

1. Run is 7 feet and rise is 10 inches per foot of run. _____

2. Span is 20 feet and rise is 12 inches per foot of run. _____

3. Span is 28 feet and rise is 6 inches per foot of run. _____

Use the illustration on page 3 of Rafter Notes for problems 4-6.

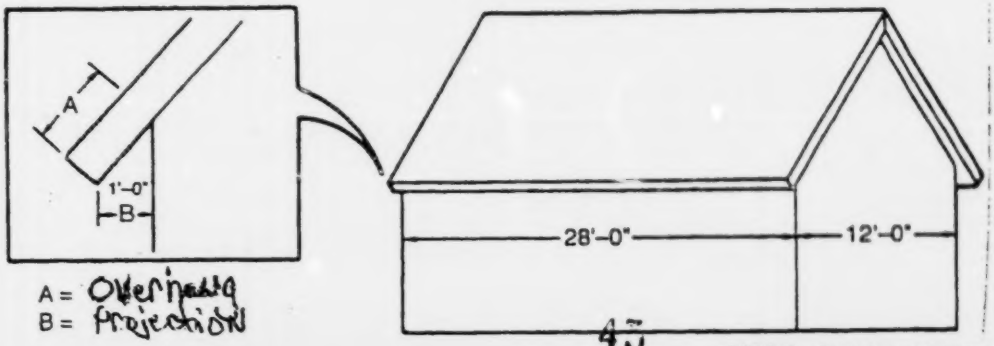
4. Express 1/3 pitch in terms of rise per foot of run. _____

5. Express ½ pitch in terms of rise per foot of run. _____

6. Find the length of a common rafter with ¼ pitch and an 8-foot run. _____

Use the rafter tables at the top of page 3 of Rafter Notes to solve the following problems. Lumber for rafters is purchased in 2-foot multiples.

7.



A = Overhang
B = projection

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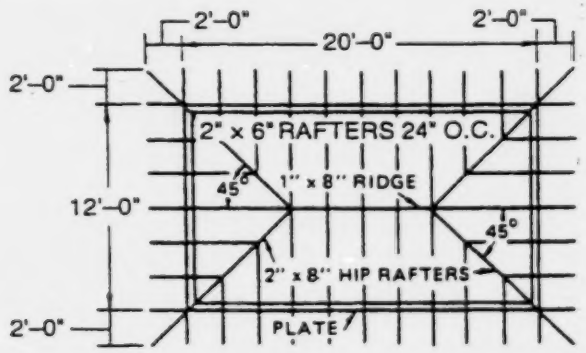
The roof shown has a rise of 6 inches for every foot of run and an overhang of 1 foot.

a. Find the length of the common rafters. _____

b. Determine the number of board feet of stock required for all of the common rafters in the roof. Stock used for rafters is 2 inches by 6 inches and is spaced 16 inches o.c.
_____ **Board feet = T x W x L in which T = thickness in inches, W = width in feet, and L = length in feet.**

8. The gable roof of a house, having a span of 24 feet and length of 36 feet, has a rise of 5 inches per foot of run. The rafters are 2 x 8-inch stock, spaced 16 inches o.c., and have a 12-inch overhang.
   a. Find the length of the common rafters. _____
   b. Determine the total number of common rafters needed for the roof. _____
   c. Calculate the number of board feet of stock required for the common rafters.
   _____

Use this illustration for the following questions.



FRAMING PLAN OF HIP ROOF

9. Find the length of the hip rafter if the roof shown has a rise of 4 inches for each foot of run. (Note that the run plus overhang for the hip rafter is 8 feet.) _____

10. What is the total length of hip rafters to be ordered for the roof shown if it has a 6-inch rise for each foot of run? _____

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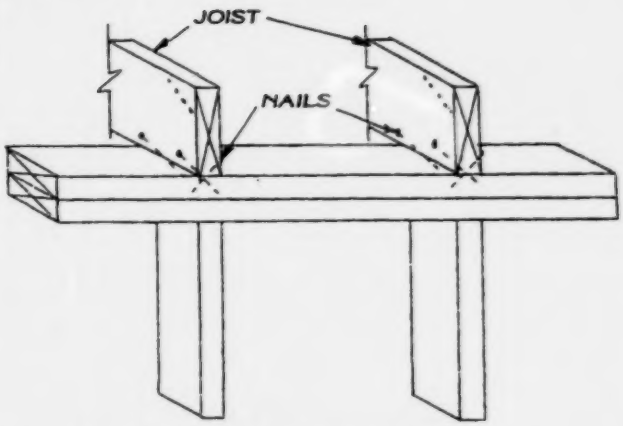
FIGURE 22



Yes No

e. Continue installing the ceiling joists until all are installed. ____ ____

12. Lay out, cut, and erect the rafters.

NOTE: Before completing the next stage of construction, you should be familiar with common roofing terminology such as span, run, rise, and pitch. Knowledge of these terms will aid understanding and reading rafter tables. Ask your instructor or supervisor for an explanation if you do not understand these terms.

a. Lay out and cut a pattern for the common rafters. ____ ____

- Use a framing square or rafter table to calculate the length of the rafter. ____ ____
- Subtract the length of the rafter by ½ the thickness of the ridgeboard. ____ ____
- Select lumber long enough for a common rafter, including the overhang, and lay it across two sawhorses. ____ ____

	Yes	No
– Use the framing square to mark the top end of the plumb cut, using the following steps:	____	____
– Determine the crown edge of the rafter.	____	____
– Make sure the toe or long point of the plumb cut is on the crown edge.	____	____
– Place the framing square across the face of the rafter near one end.	____	____
NOTE: The blade runs lengthwise with the rafter and the tongue runs across the face of the rafter.		
– Locate the inches of rise per foot of run on the tongue of the framing square.	____	____
– Mark the rafter on the outside edge of framing-square tongue.	____	____
– Measure the length of the rafter on the top edge from the toe of the plumb cut.	____	____
– Measure the thickness of the ridge board and deduct ½ that distance from the length of the rafter.	____	____
NOTE: Measure perpendicularly to the plumb cut.		

	Yes	No
– Place the framing square in position to mark the plumb cut for the bird's mouth.	____	____
NOTE: The bird's mouth should not exceed ⅓ the width of the material.		
– Place the framing square in position to mark the seat cut for the bird's mouth.	____	____
– Mark the seat cut for the bird's mouth.	____	____
– Mark the rafter on the outside edge of framing-square tongue.	____	____
– Cut only part of the bird's mouth with the circular saw, following safety procedure.	____	____
NOTE: An accurate cut on this first piece is important because it will be the pattern for cutting and remaining common rafters.		
– Keep the electric cord free of the blade.	____	____
– Be sure the automatic guard is free and retractable.	____	____
– Never lock the automatic guard in the retracted position.	____	____

	Yes	No
— Check the stock for nails, metal, or concrete before cutting.	____	____
— Make sure the blade is sharp and in good condition.	____	____
— Use good, solid support for the stock while cutting.	____	____
— Set the blade deep enough to cut through the stock only.	____	____
— Lay the saw on its base after finishing the cut.	____	____
— Finish each cut with a handsaw.	____	____
— Write "pattern" on both sides.	____	____
b. Use your pattern to mark and cut the remaining common rafters.	____	____
NOTE: While marking, be sure to keep the top flush at the bird's mouth.		
13. Frame the gable roof.	____	____
a. Place boards across the ceiling joists to walk on.	____	____
b. Lean all the rafters against the sides of the structure at each joist.	____	____
NOTE: Place them so the rafter plumb cut is up.	____	____
c. Nail one rafter at each end of the ridgeboard.	____	____

		Yes	No
d.	Lift the ridgeboard into a temporary position.	____	____
e.	Nail bird mouth cuts to the top plate.	____	____
f.	Nail bird's mouths of opposing rafters to the top plate.	____	____
g.	Toenail plumb cuts of opposing rafters to the ridgeboard.	____	____
h.	Use a temporary brace to hold the ridgeboard in place vertically until the nailing is completed.	____	____
	NOTE: It may also be checked by stretching a string along the top over the center of the ridgeboard.	____	____
i.	Erect the remaining rafters, including the end rafters.		
	NOTE: Keep the ridgeboard straight and the end rafters plumb. You can check the placement of the ridgeboard by erecting opposing pairs of rafters on both ends of the structure.		
14.	Frame the gable end.		
a.	With all rafters erected, install purlins, strongbacks, and collar beams, as required.	____	____
b.	Replace the temporary lateral bracing.	____	____
15.	Trim the rafter tails.		
a.	Mark the length of each end rafter at the determined length.	____	____

Presenter Credentials

Jodie Eiland has 28 years experience in the construction field and has taught the Gordon Cooper Technology Center Residential and Commercial Construction program for more than seven years. He took and passed the N.O.C.T.I. test in April 1996. He also took and passed A.G.C. tests for Residential Master Carpenter certification in form, frame and finish in April 1997. He holds an associate degree in business from San Bernardino Valley College.

As a construction program instructor at Gordon Cooper Technology Center, Eiland has compiled an impressive record of professional contributions to the field. He helped modify FEMA safe room plans as part of disaster recovery efforts initiated after the May 3, 1999 F-5 tornado destroyed thousands of homes in central Oklahoma. He worked with a state team that built safe room scale model prototypes used in a mobile classroom designed to help state contractors learn the best and most efficient methods of construction safe rooms. Eiland taught many hours of Skills to Rebuild classes to help area homeowners learn how to repair or rebuild their homes properly and safely. He was one of a number of Oklahomans honored during a ceremony as the Oklahoma state capitol for disaster relief work.

Eiland and his construction students have tackled a number of projects that benefited Gordon Cooper Technology Center. He planned and supervised remodeling of a portion of the school to be used as an adult training department. He directed rework of a large brick sign in front of the school. He also supervised installation of new sidewalks and ramps to improve wheelchair access to the school. He supervised conversion of two classrooms into an Education Enhancement Center and Workplace Readiness resource room. He also tackled remodeling projects for the school's nursing program and telecommunications/electronics program. He coordinated construction of a retaining wall system and enlarged the parking area for the Technology Center.

Eiland has extensive experience in the private sector. He started J.O.E. Enterprises in 1973. As a general contractor he worked new residential construction, commercial topout for restaurants and office space, residential room additions and remodels. He also has 16 years experience as a construction foreman supervising residential, light commercial, multi-residential, tilt-up, poured in place construction, and storm drain and flood control projects. Starting with plan design modifications, project budgeting and timetable projections, his duties included off-site and underground installation, construction, inspection and completion. His office duties included coordinating draws, profit and loss analysis, payroll, employee records and tax records.

As an educator, Eiland has been active in making presentations, developing and improving curriculum, initiating innovative recruitment techniques, encouraging student diversity, emphasizing customer service, and promoting positive school public relations. Eiland's class has produced two state Non-Traditional Student of the Year award winners. Eiland and his students have taken on numerous community service projects including work for an area children's museum, Kids Space park and projects for partner schools. He was asked to make an in-service parent involvement refresher presentation for his peers, chair an Oklahoma Career and Technology Education divisional sub committee and make presentations for large school and community groups. He has been called upon to work with the Oklahoma Department of Career and Technology Education 2000-2001 evaluation team.

Jodie Eiland was a presenter at the 2001 ACTE national conference in New Orleans. The presentation was titled "Integrating Adult Flex scheduling into Traditional Secondary Programs".

Presenter Credentials

Janet Capps has 26 years experience teaching secondary math in Oklahoma public schools and has taught math at Gordon Cooper Technology Center for three years. While teaching in public school Janet taught every math course offered from seventh grade through graduation. She was math department head for seven years at Shawnee High School and established and supervised a before and after school math peer-tutoring lab for ten years. While at Shawnee High School, she was also co-chairman of the North Central Accreditation Committee, a member of the Faculty Advisory Committee, a member of the Shawnee District Staff Development Committee, a member of the Textbook Selection Committee, and a member of the Shawnee High School Employment Committee. Janet also attended and presented many hands-on workshops for her colleagues.

Janet was employed by Gordon Cooper Technology Center to develop a math curriculum used to teach the math required in each vocation. She cross-referenced the National Council of Math standards and Oklahoma PASS objectives with the duty-task lists of the vocations and found that nine of the vocational programs met either geometry or trigonometry standards in the math that was required for the vocation. Janet developed the objectives, curriculum, and competency tests and presented it to the Oklahoma State Board of Education in April 2001. The Oklahoma State Board of Education granted accreditation for students in nine different programs to receive geometry or trigonometry credit in addition to the vocational credits. Janet and another fulltime math teacher go into every vocation and teach math contextual to the specific program. When geometry or trigonometry are taught the concepts are presented, then the related problems show how the concepts are used in the vocation. Gordon Cooper Technology Center is the only technology school accredited by the state of Oklahoma to give geometry and trigonometry credit in nine vocations. During the summer of 2002, the two math instructors at Gordon Cooper developed and submitted objectives, curriculum, and competency tests cross-referenced with the Oklahoma PASS objectives to the State Department of Education to teach and receive additional Contextual Geometry or Contextual Intermediate Algebra credits in four more vocational programs. The Oklahoma State Department Education granted approval for these additions based on House Bill 2886. Janet works hand-in-hand with the vocational instructors to teach the objectives as the students need them to complete the projects in their vocational class.

As a teacher at Gordon Cooper Technology Center, Janet has served on the Professional Staff Development Committee, Graduation Committee, and the State Math Career Tech Committee. She has been actively involved in attending workshops and has made several presentations to local teachers and to teachers in our sending high schools. In June 2002, Janet presented the "Math for Credit Workshop" for the Oklahoma Department of Career and Technology Education to career tech instructors and administrators across the state of Oklahoma. For the last two years, students from Gordon Cooper have placed sixth and fourth at State Contest in math.

As an educator, Janet has been active developing curriculum and constantly looking for new techniques to be used in teaching. By integrating the math skills with application, Gordon Cooper students have more success in math because they see the relevance to the vocation they have chosen to explore. They realize math is not a separate subject to be endured, but is an integral part of each vocation.

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